NASA SBIR/STTR Technologies

High Order Wavelet-Based Multiresolution Technology for Airframe Noise Prediction

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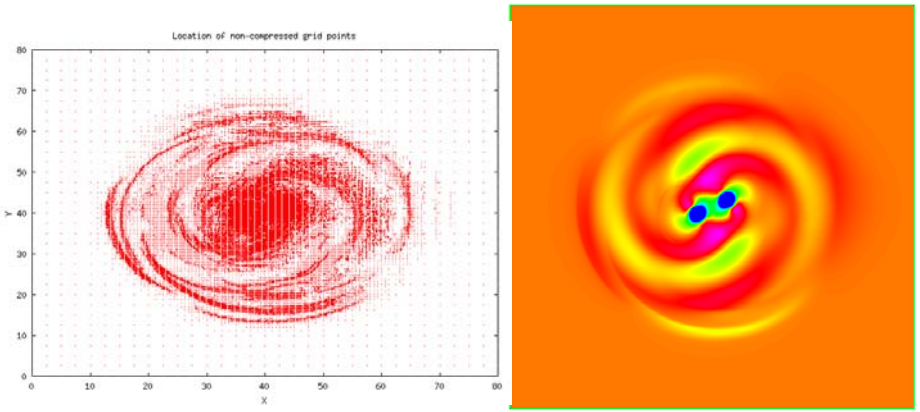
Identification and Significance of Innovation

- Noise pollution has become one of the major concerns of civilian and military aircraft designers. Noise, being a bi-product of unsteady turbulent flows, requires sophisticated analysis tools.
- An innovative multiresolution (MRES) wavelet-based technology is proposed for accurate prediction of noise sources.
- The MRES methodology does not require any prior knowledge of the flowfield characteristics.
- The MRES structure allows the implementation of higher order algorithms even though the solution data is unstructured.
- The technology will be used to analyze and compare conceptual airframe designs before building and testing costly prototypes.
- The proposed technology will provide up to two orders-of-magnitude reduction in computational time over existing methods.



Multiresolution high-order simulation of 2D noise source, acoustic waves, and the associated multiresolution grid points.

Technical Objectives

- Development of innovative, adaptive, wavelet-based compression, multiresolution (MRES) technology for prediction of noise sources and acoustic waves propagation.
- Demonstration of the MRES technology on typical airframe noise problems, such as landing gears and EET high-lift vehicles.

Work Plan

- Development of three-dimensional high-order MRES module for prediction of noise source with significant reduction in CPU cost.
- Development of advanced turbulence modules based on DES and PANS models to accurately resolve large-scale sources of noise.
- Development of acoustic analogy module based on Ffowcs Williams and Hawking method to accurately propagate acoustic signals into the far field with minimal dissipation and dispersion.

NASA Applications

- Noise source identification on Energy Efficient Transport (EET) high lift vehicles, landing gears, advanced rotor tip shapes, jet noise, rotorcraft, and propellers .
- Flow control, active twist rotors, missile plume signatures, micro air-vehicles, flutter and buffet analysis, and nonlinear lift systems,.

Non-NASA Applications

- Wing-trailing vortex dynamics, noise generated by landing gear, blade vortex interaction (BVI), and BVI induced noise.
- The MRES technology is applicable to a wide range of applications that involve embedded flow features requiring high resolutions, such as combustion instabilities, chemical and biological plume dispersion, missile plume signatures, turbomachinery, micro-fluidic systems, cavitations, biomedical, electronic cooling, and others.